Validating Methods for Estimating Endocranial Volume in Manakins (Aves, Pipridae)

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Introduction

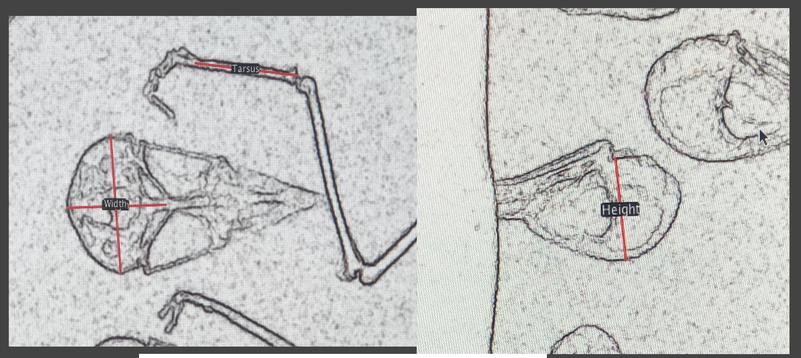
- Endocranial volume is used to estimates brain volume
- These measures are correlated, but different estimation methods may not be interchangable
- Fresh tissue measurements and MicroCT scans are highly correlated, but both are expensive, labor intensive, and impractical for many, and may require sacrifice of individuals.
- From museum skins and skeletons x-rays allow for linear measurements (LxWxH) and measuring the volume of beads decanted from skulls.
- Studies disagree on which method is most accurate and it may vary by family or sex.
- the ability to use all methods interchangably would allow the fullest extension of sample sizes.

Goals

- Compared the two common estimation methods and set our criterion for intechangability at R2=0.85.
- Measured tarsus size on x-rays and on the bones of the same specimen to determine scalling accuracy.
- Detemine correlations between reported body weight our endocranial estimates, if accurate correlations should be 0.85 or higher as is the case for fresh tissue and microCT.

Hypotheses

- Endocranial estimates will be internally reliable and interchangable.
- Tarsus measure on x-rays and bones will be nearly identical.
- Measures of allometry will be consistent with fresh specimen.



Linear Measurement Examples

Methods

General

- Weight obtained from museum records
- Tarsus is measured from the joint between the tarsometatarsus and tibiotarsus to the joint the tarsometatarsus and digits
- Only breeding adult male and females were used

Linear Measurements

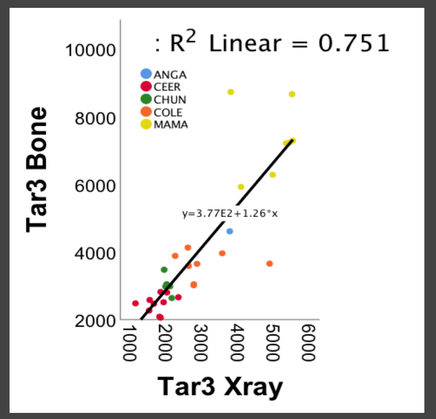
- Paper and wax molds were used to hold specimen in place on plate; plate was exposed to x-rays at 39kV for 1 minute and then developed
- Measurements are taken for the length (L), width (W), and height (H) of the braincase (see figures).
- Length is measured from anterior to the juncture of left and right pterygoid bones (as the braincase narrows from where the olfactory bulb exits) to the occipital crest at the back of the skull (using a dorsal view)
- Width is measured directly across the braincase at the widest part and is approximately perpendicular to the line drawn for the length (using a dorsal view)
- Height is measured from the tip of the frontal bone of the braincase to the lowest limit of the quadrate (using a lateral view of skull)
- Acquired measurements are input into the volumetric formula: 6∏L x W x H
- Tarsus is measured from the joint between the tarsometatarsus and tibiotarsus to the joint the tarsometatarsus and digits (on whole bird images the dorsal view is used however in other cases the tarsus is images separately)

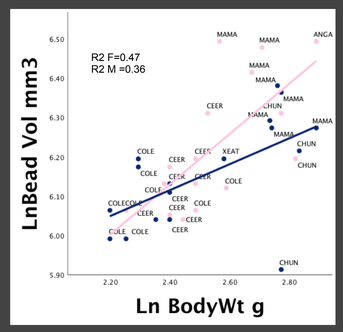
Bead Decantation

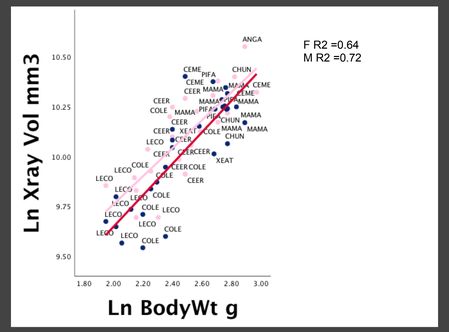
- Bead measurements were acquired by pouring 6 shot lead pellets into the foramen magnum of the skull
- Cotton was used to fill the eyesockets to keep pellets within the braincase
- Pellets were decanted with a syringe to determine the volume

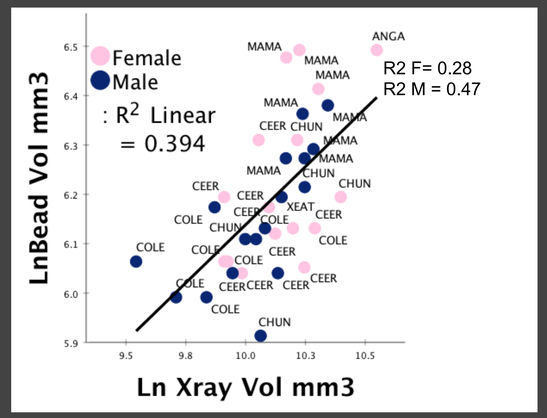
Bead Volume Technique

Results









Conclusion

- Tarsus measurements had suprisingly low R2
- Bead and Linear measurements had significant but relatively low correlations and these varied by sex.
- Linear volume was a better predictor of body weight than bead volume, suggesting more realistic allometric scalling.
- None of the hypotheses was supported.

Future Work

- Compare results of behavior/brain relationships obtained from fresh tissue to those obtained from these endocranial measures to further test internal reliability of the measures.